

not completely, breaks down all generic differences between these two genera. The prominent tubercles in no definite arrangement and the deep groove extending almost if not quite to the axil would denote it to be a *Mamillaria*; on the other hand, the exceedingly robust spines and the scales on the ovary are characteristic of the genus *Echinocactus*. It seems, however, to agree more closely with the genus *Mamillaria* as at present understood.—J. W. TOUMEY, *University of Arizona*.

THE DISTRIBUTION OF THE SPECIES OF GYMNO- SPORANGIUM IN THE SOUTH.

It is a somewhat remarkable fact that no less than six very distinct species of *Gymnosporangium* are parasitic on *Juniperus Virginiana*. These species are all found in the states bordering on the Gulf of Mexico, and so far as present data indicate, two of them are peculiar to this region. The other species are of much wider distribution, but we still lack reliable information regarding the extent of range of any of the species of the genus. The species may be arranged in groups as follows:

Producing somewhat globose galls.

Perennial species.

Gymnosporangium globosum Farlow.

Gymnosporangium Bermudianum (Farlow) Earle.

Annual species.

Gymnosporangium macropus Link.

Gymnosporangium sp.¹

Producing slight enlargement of stems or fasciation of branchlets.

Perennial species.

Gymnosporangium clavipes Cooke & Peck.

Gymnosporangium nidus-avis Thaxter.

Of the above species *Gymnosporangium macropus* is the most conspicuous and widely distributed, its roestelia occurring on the wild crab and the cultivated apple. We have also found it during the past year in Alabama growing on *Cratægus spathulata*. Its general distribution is doubtless coextensive with the wide distribution of its host, since its most common alternate host is as widely cultivated. In the

¹The assignment of a name and description to this species has been left to Dr. Thaxter, to whom the writers are indebted for numerous comparisons of material and verifications of species during the past year.

south it is usually very common. It is found in South Carolina (*Ravenel*, Fungi Carol. no. 85), Georgia, Alabama, Mississippi, and is also reported from Florida (*Webber*) and Texas (*Jennings*). An interesting feature of its development occurred during the present season in Alabama, showing the effect of the season on habit of growth. An early rain caused the germination of some of the teleutospores, so that there was an early crop of roestelias produced on the apples. At the time of the next rain, and after an interval of about six weeks, the remainder of the teleutospores were brought to germination, and at the same time the effects of the earlier sowing had already produced the characteristic spots and yellow thickenings of the roestelias and the spermagonial stage was reached. Toward the end of July the new galls for the next season had already developed and had attained considerable size. With all our knowledge of this common species, we are still uncertain as to what may be the ordinary time and method of the formation of this gall on *Juniperus*.

Gymnosporangium clavipes, next to *G. macropus*, is the most common species in central Alabama. Since it produces no enlarged gall, its presence is often overlooked until after the germination of its teleutospores, when its semi-dried gelatinous spore masses render it quite conspicuous. Its Roestelia is found on the cultivated quince and on various species of *Cratægus*. Its range appears to be confined to the Appalachian region. In the south it occurs in South Carolina (*Ravenel*, Fungi Amer. nos. 272, 502), Georgia, Alabama, and Mississippi.

An undescribed species of *Gymnosporangium* is the next most common in Alabama, and appears also to be frequent in Mississippi at Starkville (*Tracy*) and Ocean Springs (*Earle*). It is apparently an annual species producing galls similar to those of *G. macropus*, but of a peculiar red brown color and luster, reminding one of *G. Bermudianum*. In shape they approximate those of *G. globosum*, and are often very small, with single spore masses, but frequently have a peculiar ray like arrangement of four or five spore masses arranged at right angles to the (short) axis of the gall; occasionally they are larger, even reaching two or three centimeters in diameter. They are entirely devoid of the characteristic bark colored flakes of *G. globosum*. The spore masses are darker, shorter, broader and more conical than those of *G. macropus*, and are wholly unlike the dark wedge shaped masses of *G. globosum*. The spore characters are also different from either of the two allied species. The roestelia of this interesting species is sus-

pected to be a peculiar undescribed form first discovered by Professor G. F. Atkinson in Alabama, and since by one of the writers on *Cratægus spathulata*. Cultures of the Ræstelia were attempted in the greenhouse on young plants of *Cratægus* transplanted from the woods (which afterwards proved to be *C. parvifolia*), but with negative results. Preparations are in progress to make more extended cultures another year on *C. spathulata*, which is one of the common species of haw in the vicinity of Auburn.

Gymnosporangium globosum is rare at Auburn, Alabama, occasional at Starkville, Mississippi (*Tracy*), and found once at Ocean Springs, Mississippi (*Earle*). A second form of this species, whose characters have not yet been fully studied, also occurs in Mississippi.

Gymnosporangium nidus-avis appears to be quite rare in central Alabama, only three specimens having been found the present season, all of them the branch form, and none of them producing the peculiar fasciation of the branchlets so common in eastern Massachusetts. They appear very early in the south, the teleutospores germinating during the rains of the latter half of February. A marked feature of the branch form of this species, readily distinguishing it from *G. clavipes*, is the peculiar orange colored stain left on the somewhat hardened inner bark of the host; this is perceptible even in specimens long collected. The species seems to have a wide distribution, in the south commencing with South Carolina (*Ravenel*, Fungi Car. no. 87, distributed as *G. Juniperi*), and extending through Georgia (*Ravenel*, Fungi Amer. no. 791, distributed as *G. conicum*), Alabama, and Mississippi. A peculiar form appears in the collection of the Division of Vegetable Pathology and Physiology, which Professor Galloway has kindly permitted us to examine, under the name of *G. juniperinum*, collected at Fredericksburg, Texas, by F. Grasso in 1893 and again in 1895. It resembles closely certain foliicolous forms of *G. clavipes*, but the spore masses are larger and more prominent and the pedicels are not enlarged. It is desirable that we have as wide a series of specimens as possible from the entire Gulf region in order to determine more fully the limits of these species as well as their geographic distribution.

The last species of the list, *Gymnosporangium Bermudianum*, has the most limited distribution in the Gulf region, and is as remarkable in its life history as in its distribution. It is known from the Bermuda Islands, where it was first collected by Professor Farlow and described

by him as *Æcidium*,² and from Ocean Springs, Mississippi, where one of the present writers discovered its true gymnosporangial character, and also its peculiar roestelia, in 1892. The Mississippi material was first collected in January 1887 and sent to Professor Farlow, so that Mississippi is one of the type localities of the original description. Later in the spring of 1892 the teleutospores were discovered, and in October of the same year the roestelia with its distinct, long exerted, lacerate peridia was found on the same galls, the old broken bases of which must have formed the peridia of the supposed *Æcidium* as originally described. The species, therefore, unlike all its congeners, produces its æcidial and teleutosporic stages on the same host, from the same gall, and in all probability from the same mycelium. The species can scarcely be said to be common, though when found it usually infests considerable portions of the tree in which it occurs. Several stations are now known for the parasite at distances of a few miles from the original tree where it was found in 1887.

The conditions of growth manifested by the last species introduce a new and interesting problem into the question of the evolution of the various species of the genus. At one extreme of the series we have *G. macropus* and its new ally, annual species, producing their roestelias on various Pomaceæ and consequently dependent for their perpetuity upon the success of their annual sowing and interchange of host. Then we have the various species that are perennial and thus capable of continuing from year to year without the intervention of the roestelia stage, but with which they continue to propagate themselves more widely. Then, finally, we have *G. Bermudianum* producing both stages on the same host and therefore independent of the Pomaceæ for its continuance. The details of this evolution will constitute a further problem.—LUCIEN M. UNDERWOOD and F. S. EARLE, Auburn, Alabama.

BOTANICAL APPLIANCES.

(WITH PLATES IX AND X.)

BOTANICAL appliances serve for investigation and demonstration, and while some of the following appliances were devised for special work they have also been used in demonstration in a practical course of vegetable physiology in our laboratory.

² *Æcidium Bermudianum* Farlow, BOT. GAZ. 12:206. 1887.